Geophysical Research Abstracts
Vol. 19, EGU2017-14938, 2017
EGU General Assembly 2017

Heat budgets of crustal and mantle rocks revealed by exchange thermometers involving cations with differing diffusivities

Dimitrios Kostopoulos (1) and Evangelos Moulas (2)

(1) National & Kapodistrian University of Athens, Faculty of Geology & Geoenvironment, Greece (dikostop@geol.uoa.gr),
(2) ETH Zurich, Inst. f. Geochemie und Petrologie, Earth Sciences, Zurich, Switzerland

The development of two new thermometers based on exchange of cations, between orthopyroxene (opx) and clinopyroxene (cpx), with differing diffusivities, and employing a novel thermodynamic approach, has allowed us to decipher the thermal history and tectonic setting of crustal and mantle rocks containing these minerals. Calculated temperatures reflect the temperatures at which the diopside (i.e. CaMg; hereafter TDi) and Cr-Tschermak's (i.e. CrAl; hereafter TCrTs) exchange between opx and cpx were effectively blocked. Granulites and subcontinental lithospheric mantle peridotites invariably show TCrTs>TDi, suggesting slow cooling with CaMg exchange blocking at lower T compared to CrAl exchange as a result of faster vs. slower diffusion rates respectively. Volcanic rocks show TCrTs=TDi, indicating "freezing" of the above exchange reactions immediately upon eruption. Cumulate rocks show either TCrTs≈TDi or TCrTs<TDi demonstrating either relatively rapid cooling or T perturbations due to chamber processes such as magma replenishment. Mantle peridotites from ophiolites and oceanic back-arcs as well as most abyssal peridotites show TCrTs<TDi, clearly pointing to active melt percolation in these settings. Garnet lherzolites from the SuLu ultrahigh-pressure metamorphic belt define, to the best of our knowledge, the coolest geotherm ever recorded by terrestrial rocks (surface heat flow∼33mW/m2). This is consistent with a lithosphere thickness of about 250km requiring, in turn, the removal of 150km from the lithospheric keel beneath eastern China since the Proterozoic.